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'How to do': digital-interactive-interpretation course for stress echocardiography

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Why?	To improve stress echocardiography interpretation standards, we introduced a structured 5-day interpretation course in 2017. In order to deliver the course during the world-wide pandemic, we transformed the existing boardroom style, workstation-based, interactive course into a cloud-based digital entity maintaining the same features.
How?	On completion of 6 lectures via live webinars, 15 participants performed, fully GDPR compliant, 80 recorded case analysis using a web-based reporting system over the course of 5 days. After self-reporting and generating preliminary reports the joint case review with the faculty, resulted in finalization of the reports and provided individual feedback for the participants. By the 5th day, participants had collected 80 reports for their e-logbook and were ready to sit the digital interpretation exam.
Results	Eighty-eight percent of participants passed the e-exam and received a certificate of completion with 15 re-accreditation and 30 CPD points by the British Society of Echocardiography and Federation of the Royal Colleges of Physicians, UK, respectively. The feedback by the participants was praising the pre-course provision of lectures and digital aids, the conduct of the course by the faculty and the technical support with an average score of 4.7 for each, on a scale from 1 to 5.
Conclusion	Our experience proved that interactive, multi-day; hands-on reporting course can be delivered using the digital platform. Online interpretation courses have great potential to improve the competency of imaging specialists. This digital teaching model could be suitable in other imaging-based training courses like cardiac CT and MRI.

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Graphical Abstract
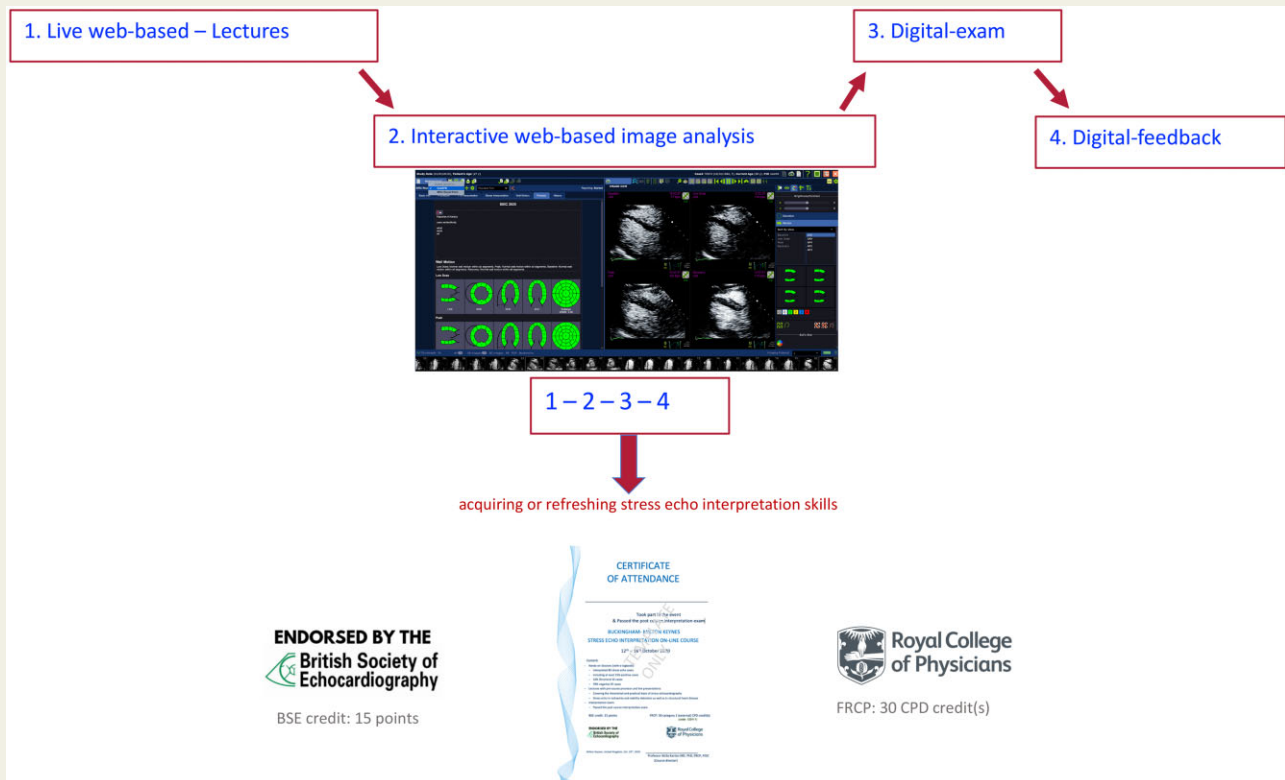
Live – Digital - Stress Echo Interpretation Course – Flowchart
Integrative approach in delivering live stress echo interpretation, hands-on course utilizing digital technology (from live webinar-based lectures, interactive web-based image analysis, digital exam to digital feedback). The outcome: acquiring or refreshing stress echo reporting skills and the re-accreditation and CDP credit points by the professional bodies.
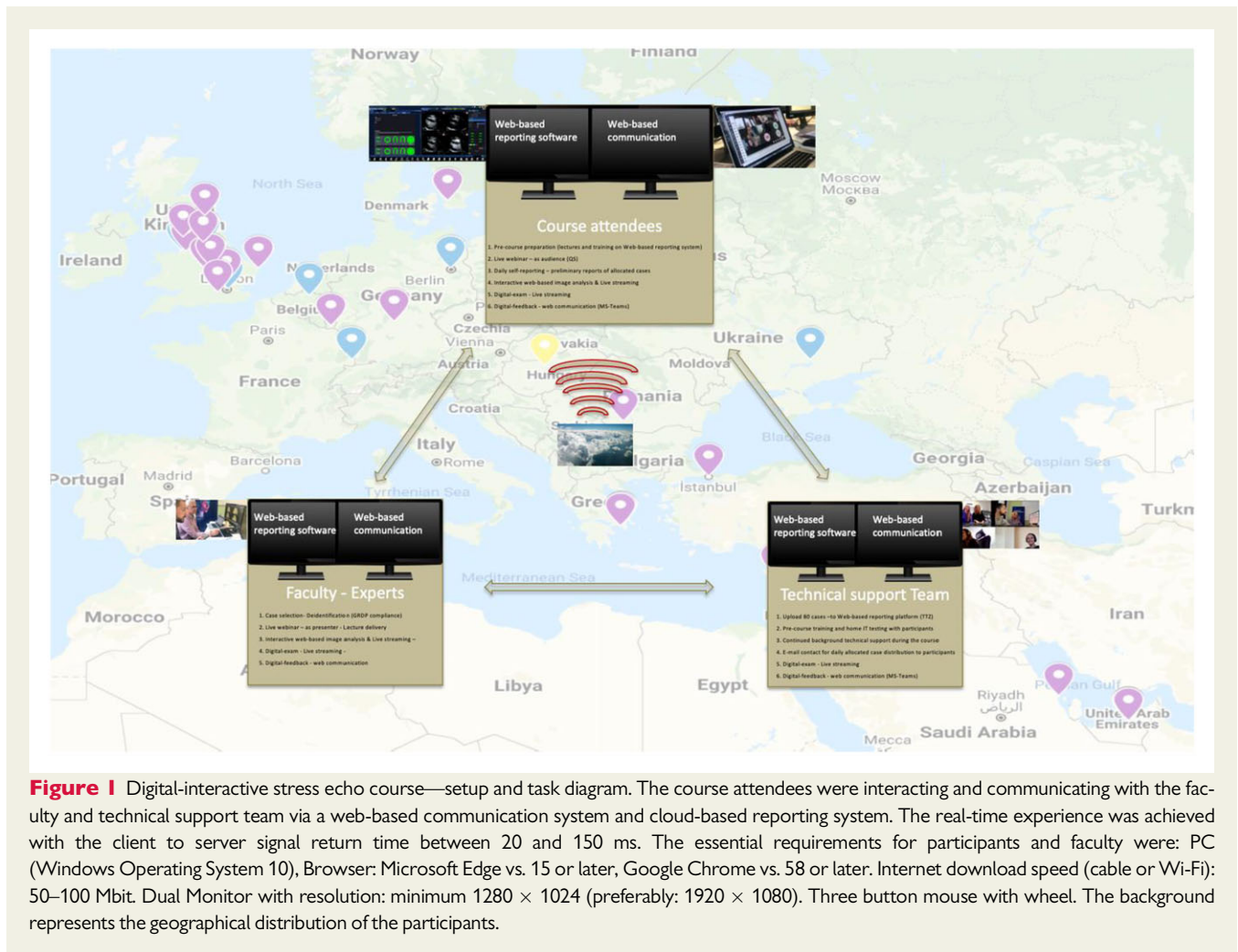
Introduction

Stress echocardiography has become an indispensable tool for assessing patients with suspected or known coronary artery disease, valvular disease, and cardiomyopathy[1–3] Professional and scientific organizations provide recommendations for training and competency examination, however, there is no formal training for analysing and interpreting stress echocardiography studies.[4]

The stature of stress echocardiography has been underrated due to the lack of quality of standard of interpretation owing to the absence of formalized training. Indeed, vast number of physicians and sonographers currently performing stress echocardiography had no structured training in performing or interpreting stress echocardiography images. Furthermore, another problem arises from the increasing number of referrals of low-risk patients for the exclusion of coronary artery disease thus, the trainees see less patients with pathological findings.

Traditional boardroom style Stress Echo Interpretation Course

After identifying this gap in training, we introduced the Stress Echo Interpretation Course (SEIC) in 2017. In a boardroom, up to 20 attendees interpreted 150 cases on individual workstations during the 5 days course using a commercially available reporting program. The left ventricular regional wall motions were compared by stages and views to generate the 17 segments bullseye plot and conclusion on the findings were discussed. For each case, the attendees had 10 min to analyse followed by 5 min of joint discussion led by the participants and facilitated by the expertise of two cardiologists with broad experience in stress echocardiography. The finalized reports were then included in the participants e-logbook. Prior to the reporting sessions, 16 live lectures on the essentials of stress echocardiography were provided followed by a tutorial on how to use the workstations and interpret stress echo images.

Figure 1 Digital-interactive stress echo course—setup and task diagram. The course attendees were interacting and communicating with the faculty and technical support team via a web-based communication system and cloud-based reporting system. The real-time experience was achieved with the client to server signal return time between 20 and 150 ms. The essential requirements for participants and faculty were: PC (Windows Operating System 10), Browser: Microsoft Edge vs. 15 or later, Google Chrome vs. 58 or later. Internet download speed (cable or Wi-Fi): 50–100 Mbit. Dual Monitor with resolution: minimum 1280 × 1024 (preferably: 1920 × 1080). Three button mouse with wheel. The background represents the geographical distribution of the participants.

The feedback was always exceptional and urged us to upscale this training event both in size and frequency. The SEIC has been endorsed by the European Association of Cardiovascular Imaging in 2017 and by the British Society of Echocardiography (BSE) in the subsequent years with reaccreditation points and continued professional development points (CPD) awarded by the BSE and Federation of the Royal Colleges of Physicians, London (FRCP), respectively.

The course in 2020 was influenced by the COVID-19 pandemic. The organizers unanimously agreed that the course must go ahead with adherence to the Centers for Disease Control and Prevention's social distancing guidelines. The only option was to develop a Virtual-SEIC, maintaining the interactive and hands-on reporting features.[5] After few months of preparation, the dedicated team of professionals identified the necessary platform and logistics and were ready to deliver the first Digital-SEIC in October 2020 with no compromise.

Digital-SEIC Course—the transformation

The main pillars of the Digital-SEIC were a web-based reporting platform (TOMTEC Zero™, TOMTEC Imaging GmbH), and the web-based communication system. The cloud-based server provided a secure coverage of approximately 3200 km radius around London. To achieve a real-time experience the client to server signal return time was between 20 and 150 ms. GoToWebinar and MS-Teams platforms were used for web-based communication and live webinars. Participants needed to provide the minimum specification of personal computer, operating system, web-browser, and the internet connection speed to enable efficient participation with minimal risk of technical disruption during the course (*Figure 1*).

Pre-course preparation

Participants were asked to engage in a pre-course preparatory work and were provided with all the theory lectures. This reduced the time needed to spend on delivering the 16 lectures and only focused on the 6 essential webinar lectures that were needed to consolidate the joint reporting sessions. We have compiled a YouTube video (https://youtu.be/vgTYmHJExRI) demonstrating the workflow of the web-based reporting software that was provided to all participants a week before the course. This was reinforced with application specialists who had been in contact with all attendees before the course. This preparation enabled all participants to access and interpret the images and interact with the faculty during the scheduled time slots with little technical difficulty in the image streaming, live webinars and interaction with the faculty (*Figure 1*).

Video 1 "How to do" – Digital-interactive-interpretation course for stress echocardiography.

Online interpretation

After the essential webinar lectures on the first day and the reiteration of the web-based stress echo analysis, software with 5 training cases over the subsequent days 80 uploaded cases prepared by the faculty were provided to the participants via e-mail as individual case summaries in consignments of 20 every evening (to list the indication, risk factors, medications, type of stress modality, cause of termination, and image quality and interpretability). The case mix followed the recommendation by the BSE, with more abnormal cases as requested by the prior SEIC attendees; 56% normal, 15% structural, and 29% abnormal cases. The stress echo findings, conclusion, and recommendation of the reports were unfilled. The participants had access to the echo images via the web-based reporting system for self-interpretation to generate a preliminary report over the 3 h sessions in the morning and in the afternoon (10 cases each). The preliminary reports were then finalized during the joint faculty sessions over 2 h in the early afternoon and in the evening. Each participant was called in turn to lead the interpretation of their allocated case and score the wall motions in each view and stages that generated a bull's-eye-plot. The final findings, conclusion, and recommendations were drawn by the faculty. The finalized reports, downloaded by the participants, served as part of their e-logbook (*Figure 1*).

How to motivate participants remotely

During the self-interpretation sessions, the faculty was able to observe the participants progress in reporting via the reporting system and where necessary were able to enhance reporting on an individual basis. The joint interactive, faculty led session was also monitored with the online networking system and was used to engage each participant actively in the discussions. This improved course efficiency and helped in the learning process as well as gave a human touch mimicking face to face scenario with the audience. The background support stuff was able to deal with any instantaneous queries or technical glitches at any time very efficiently and contributed to a smooth running of the course (*Figure 1*).

End-of-course—digital exam

The end of course exam was delivered online with strict timing in adherence to the BSE stress echo interpretation exam guidance.[4] Twenty multiple-choice questions with five possible answers compiled by the faculty were delivered online using the GoToWebinar link to allow smooth transitions among questions, images, and answers. Participants had to choose the single best answer on the digital answer sheet after each question before progressing onto the

next. The digital exam, with the strict control, was very efficient in minimizing the opportunity of inappropriate activities (such as using aid, recording, discussing etc.). The success rate of the examination was 88% with an average pass mark of 70% as one of the metrics of the course amongst a wide variety of attendees form consultant cardiologists, junior doctors, research fellows, to highly specialized cardiac physiologists from across Europe and the Middle East.

The participants were provided with their e-logbook of 80 reported cases, 15 re-accreditation, and 30 CPD points by the BSE and FRCP respectively.

Feedback

The digital feedback forms were completed by all attendees as a prerequisite for the course certificate and accreditation points. Fifty percent of the attendees joined the course to learn and develop interpretation skills and the other 50% were experts with the aim to refresh their stress echocardiography interpretation knowledge. Thirty-three percent of participants had performed over 200 cases and 22% did more than 500 cases during their career. Sixty-six percent were from a large or university hospitals and the rest from small- to medium-size hospitals.

Eighty-eight percent of attendees never used the TomTec imaging analysis software before and 71% found it easy to use. Ninety-four percent of the participants expressed their overall contentment as very satisfied with the Digital-SEIC-2020. They were praising the precourse provision of lectures and digital aids, the conduct of the course by the faculty and the technical support with an average score of 4.7 for each, on a scale from 1 to 5 (1 being dissatisfied and 5 very satisfied). Participants found the Digital-SEIC unique and would recommend it as a future style of course delivery: 4.5.

Conclusion

The recently established stress echo courses provide basic skills of interpretation. The Digital-SEIC proved that an interactive, multi-day; hands-on reporting course can be delivered using a digital platform. Although, this experience was forced upon us by the world-wide pandemic, it may become the future way of delivering this course, with the added benefit of flexibility and cost efficiency to the attendees, versatility and scalability for the organizers and not least environmentally friendly to our ecosystem. This virtual experience can be considered as a training model for other imaging modalities and beyond.

Lead author biography

Professor Kardos graduated with a distinction from Albert Szent-Györgyi Medical School Szeged, Hungary. He was a Research Fellow at the Heart Centre in Bad Krozingen, subsequently a Research Fellow of the European Society of Cardiology at the University Department of Cardiovascular Medicine in Oxford. Having been appointed as a Consultant Cardiologist in 2003 he is a clinical lead in multimodality cardiac imaging, and the Associate

Director of Research at Milton Keynes University Hospital. He has numerous Fellowships & Memberships of over 10 National and International Professional Societies. He is an Honorary Senior lecturer to the Division of Cardiovascular Medicine University of Oxford and has a personal Chair in Cardiovascular Medicine at University of Buckingham. Professor Kardos is a Founder and course director of several accredited advanced echocardiography teaching courses since 2007 and has published over 100 scientific papers and 3 book chapters.

Data availability

No new data were generated or analysed as part of this paper.

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